IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Brenton Robert Steele — Confirmation No.: 2370

Application No. 10/596,122 — Filing Date: June 28, 2006

Docket No.: MONK-1005US — Examiner: Fatimat O. Olaniran

For: Method and Apparatus for Producing Adaptive Directional Signals

PRE-APPEAL BRIEF REQUEST FOR REVIEW

Initially addressing the first paragraph numbered 1 in the final Office Action mailed March 19, 2010, we note the Examiner's assertion that "Feng discloses deriving different responses from microphones combinations (col. 4 lines 1-40)". However, it is not the case that Feng col. 4 lines 1-40 discloses combining sensor signals to derive the polar patterns shown in Figures 2-5. Rather, each directional pattern in Figures 2-5 is an example of a fixed directional pattern output by particular hardware, prior to any signal processing such as combining.

One example given by Feng (col. 4 line 20) is a bi-directional "pressure-difference type microphone". To revisit the basic nature of a pressure-difference bi-directional sensor, such a sensor consists of two input ports passing acoustic signals to opposing sides of an electro-acoustic transducing membrane or diaphragm. Because acoustic signals arrive from opposing sides, the membrane itself effects a "mechanical subtraction" of the two acoustic signals. To carry acoustic signals from outside a device casing to the ports of any microphone, input tubes or like conduits are invariably provided. These tubes can slide on friction mountings and thereby alter the signal path length, can be deformed by being pinched or compressed within or by the casing, or can be occluded by introduced material. These and other physical path changes affect acoustic input paths of both omni- and bi-directional sensors. However bi-directional sensors cannot be re-matched to compensate for path changes because signal subtraction occurs in the hardware and thus cannot be tuned. Feng's reliance upon directional sensors precludes the possibility of any matching either for device mismatches or degradation.

By contrast the present invention, by exploiting two omni-directional sensors, carries out signal subtraction not in hardware but in software or signal processing. This allows the omni-directional microphone output signals to be phase-adjusted or modified in amplitude (e.g. see gain 35 in Fig 3, page 8 lines 5-11 and page 9 lines 27-29 of the present application) prior to any subtraction. This permits phase and amplitude matching to be optimized at the time of manufacture to compensate for manufactured device mismatches, and also permits re-optimization over time, as and when physical components degrade or alter. Thus the present invention inherently gives significantly more flexibility in the manner in which the first omni-directional signal and second bi-directional signal may be matched in amplitude and phase.

The processing of the present invention works upon two specifically selected signals: a first signal which is omni-directional, and a second signal which is bi-directional, with both signals being derived from the same two omni-directional microphones. This is a critical selection which is not disclosed or suggested by Feng. This arrangement provides a highly effective, elegant and simple

means to ensure that the bi-directional signal is precisely in phase with the omni-directional signal in the predetermined (e.g. forward) direction, while ensuring that the bi-directional signal is precisely 180 degrees out of phase with the omni-directional signal in the opposite (e.g. rear) direction. Such precise phase configurations are an essential factor in effective operation of a processing system in which it is required that: (1) addition of the two signals when equally weighted will effect precise cancellation (i.e. a deep null) in the rear direction; (2) subtraction of the two signals when equally weighted will effect precise cancellation in the forward direction; and (3) precise cancellations will occur at other polar angles under suitable weightings. In contrast, basic theory indicates that the use in Feng of different hardware and different types of hardware as the origin of each signal path, with no opportunity for matching (as previously explained), makes it almost certain that the signals will not be closely phase aligned in the above manner. It is thus inherent in the teaching of Feng that precise phase alignment will be exceedingly difficult to obtain, inevitably resulting in poor nulls. Feng in no way gives any teaching, suggestion or motivation to implement the specifically selected (and claimed) elements of the present invention for the purpose of addressing this significant problem.

It is further noted that hearing aids in particular, and to a similar extent Bluetooth headsets and the like, have very limited physical space to accommodate microphone ports. For example in hearing aids the maximum port spacing can typically be no more than about 1 centimeter. In this space must be mounted not only microphone ports at relative positions to maximize performance, but also other elements such as wind shields to reduce wind noise. Utilization of this space is a difficult task. The present invention, in utilizing two omni-directional microphones, requires only two microphone ports. Feng requires that both sensors 22 and 24 are directional, thus necessitating at least four microphone ports in any such device, significantly hampering the achievable performance of each hardware sensor.

Feng (col. 3 lines 62-67) states that directional sensor 22 may have any of the fixed hardware responses shown in Figures 2-5 and discussed at col. 4 lines 1-40, as may directional sensor 24. That Feng (col. 4 lines 1-40) discusses the respective basic polar characteristic of each such example of a fixed hardware directional sensor is not contested by the applicant. However, Claim 1 of the present application requires "deriving from two omni-directional microphones a first signal having an omni-directional polar pattern and a second signal having a bi-directional polar pattern". Feng col. 4 lines 1-40, and indeed the entirety of Feng, nowhere discloses nor suggests deriving first and second signals from the same two omni-directional microphones, the first signal being omni-directional and the second signal being bi-directional.

Feng describes a system which relies on two or more directional sensors that are combined to give an adaptive directional signal. Notably, it is the sensors of Feng which are directional. This is in contrast to claim 1 of the present application which, as previously amended, requires that the two signals be derived from omni-directional microphones. Applicant does not contend that omni-directional and bi-directional sensors *per se* are not known. However the architecture of Feng

necessarily uses directional sensors and, when seeking to effect adaptive directionality therefrom, this inextricably requires a different type of signal processing optimization. Consequently, the Feng architecture is fundamentally different and cannot achieve the same type of behavior and performance as the present invention. In contrast, the architecture of the present invention necessarily uses two omni-directional sensors (as is set out in claim 1), to enable this invention's very particular architecture (also set out in claim 1) to function and achieve its performance. The signal processing techniques of Feng cannot be used in the architecture of the present invention, and simply would not work. Accordingly, even if it were obvious (which is not conceded) to try to use omni-directional sensors in the architecture of Feng, this would not yield the present invention, nor even a useful arrangement.

The first Paragraph numbered 1 in the 19 March 2010 final Office Action further states that "the adaptive signal processing is applicable to microphones of various response patterns (col. 18 lines 30-37)". However, Feng at col. 18 lines 30-37, and indeed the entirety of Feng, nowhere discloses nor suggests deriving first and second signals from the same two omni-directional microphones irrespective of the presence or absence of any bi-directional microphones. In more detail, we note Feng (col. 18 lines 32-35) states "In other alternative embodiments, at least one acoustic sensor is of a directional type while at least one other of the acoustic sensors is of an omni-directional type". This statement thus mentions the possibility of including omni-directional microphones in addition to directional microphones. Applicant notes Feng gives no further disclosure of how such a system may be implemented or how the additional omni-directional microphones may advantageously be exploited. Much less does this statement give any teaching or suggestion to derive first and second signals from the same two omni-directional microphones, irrespective of the presence or absence of any bi-directional microphones, as required by claim 1 of the present application.

Further, Feng (col. 18 lines 35-37) states "In still other embodiments based on more than two sensors, two or more sensors may be omnidirectional and/or two or more may be of a directional type". This statement applies to a system with "more than two sensors", and thus gives no teaching or suggestion to derive first and second signals from the same two omni-directional microphones, irrespective of the presence or absence of any bi-directional microphones, as required by claim 1 of the present application. Applicant notes that the "and/or" language of Feng (col. 18 line 37) at most entertains the possibility of a system comprising three or more omni-directional sensors. Accordingly, this gives no teaching or suggestion to derive first and second signals from the same two omni-directional microphones. Moreover, Feng nowhere teaches any sort of signal processing which might be used to handle signals from three or more omni-directional sensors. Applicant again notes that all processing methodologies taught throughout the remainder of Feng inextricably arise from the use of directional sensors and are ineffective with omni-directional microphone signals.

Applicant turns now to the second final Office Action mailed August 3, 2010. Referring to the second paragraph numbered 1 in the second final Office Action, Applicant appreciates the Examiner's

indication of the allowability of claims 4, 9, 10, 12, 22. However, claims limited to an exemplary equation are considered to provide excessively narrow protection for the advance made by the inventor of this invention, given that at least the above noted features are neither disclosed nor suggested in the prior art.

Items 2 and 3 of the second final Office Action reject claims 1-3, 5-8, 17-21, 23-25 and 32 under 35 USC 103(a) in light of Feng. At page 2 final two lines and page 3 first line, the second final Office Action asserts that Feng (Fig. 3 and col. 4, lines 19-30) discloses "deriving from two omni-directional microphones a first signal having an omni-directional polar pattern and a second signal having a bi-directional polar pattern". However, Applicant again notes that Fig. 3 is a graph of the response pattern of a single microphone (see col. 4 line 20). The microphone itself is bi-directional (col. 4 lines 20-21), not omni-directional. Fig.3 and col. 4, lines 19-30 thus fail to disclose any omni-directional microphones whatsoever, much less providing any disclosure or suggestion of deriving first and second signals from the same two omni-directional microphones. Feng (col. 4, lines 16-18) refers to the circular polar pattern of an omni-directional microphone by reference to "outer circle OC" in Fig. 2, but this is "in contrast" (col 4, line 16) and clearly present merely for comparative purposes in order to define what is not considered to be a directional microphone, with Feng (at col. 3 line 62) making clear that the sensors 22 and 24 discussed throughout col. 4 are in all cases directional.

The second final Office Action at page 3, first four lines, asserts that Feng (Fig 6-7, col. 6, lines 13-30, col. 18, lines 30-37) discloses "constructing the combined adaptive directional signal from a weighted sum of a first signal weight of the first signal and a second signal weight of [the] second signal". However, it is again noted that Feng nowhere discloses constructing a combined adaptive directional signal from a weighted sum of first and second signals, where both signals have been obtained from the same two omni-directional microphones, and where the first signal is omni-directional and the second signal is bi-directional.

The final Office Action at page 3, line 7 concedes that Feng does not disclose the specific selection of the second signal having a bi-directional polar pattern. At page 3, lines 10 to 12 the Examiner contends that "it would have been obvious to one of ordinary skill in the art at the time of the invention to try various directional microphones". Applicant notes that the present invention does not use directional microphones, but rather uses omni-directional microphones. Applicant further notes that, for the reasons set out in the preceding discussion, even if it were obvious (which is not conceded) to try to use omni-directional sensors in the architecture of Feng, simply substituting omni-directional microphones into the architecture of Feng would be ineffectual and would not yield the present invention, nor even a useful arrangement.

The final Office Action at page 3, lines 12-14 states that "obtaining various directional responses from an omni-directional microphone is very well known in the art at the time of the invention as evidenced by Feng (col. 4, lines 1-40)". As noted previously in this Brief, Feng col. 4,

lines 1-40 makes no disclosure whatsoever of obtaining directional responses from omni-directional microphones. Also, as noted previously in this Brief, even if it were obvious (which is not conceded) to try to use omni-directional sensors in the architecture of Feng, this would not yield the present invention, nor even a useful arrangement.

The Final Office Action at page 3 lines 10, 15 and 17 asserts that it would have been obvious to one of ordinary skill in the art to reach the present invention. However, as an indication of the non-obviousness of the present invention, it is noted that this invention has been assessed and licensed by major companies including leading hearing aid manufacturers such as ON Semiconductor Corp. (formerly Sound Design Technologies Ltd), IntriCon Corp, America Hears Inc., a G.N. Store Nord A/S subsidiary GN ReSound Ltd (under the brand Interton), and other hearing aid manufacturers, and has also been licensed in confidence to several Tier 1 Bluetooth Headset manufacturers who have sold millions of units which utilize this invention. These licensees are leaders in these fields and employ persons having much greater than "ordinary" skill in the field who have carefully assessed this invention and recognized the significance of the present invention and consequently elected to take a license to this invention. It is respectfully submitted that this further confirms that persons of merely ordinary skill in this field most certainly would not have found the present invention to be obvious.

As a further indication of the non-obviousness of the present invention, it is noted that the corresponding Australian Patent (AU 2004310722) has been granted by the Australian Patent Office.

It is respectfully submitted that the preceding arguments illustrate that claim 1 is novel and non-obvious. For brevity the present Brief focuses on the rejection of claim 1, which is in no way an acquiescence to the reasoning of the subsidiary rejections of claims 2, 3, 5-8, 17-21, 23-25 and 32. Further, previously presented arguments not repeated here are not abandoned but are omitted for brevity. The same arguments apply to all of the remaining claims in the application either because they depend from claim 1 or because they include the same limitations as claim 1 which are relied upon above in support of the patentability of the invention. The secondary references cited by the Examiner do not cure the deficiencies of Feng discussed herein nor does the Examiner allege that the features lacking from Feng are found in the secondary references. Favorable consideration and withdrawal of the rejections of all claims which stand rejected, is requested.

Respectfully submitted,

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/Kevin J. Dunleavy/
Kevin J. Dunleavy
Registration No. 32,024

KNOBLE YOSHIDA & DUNLEAVY, LLC
EIGHT PENN CENTER, SUITE 1350
1628 JOHN F. KENNEDY BOULEVARD
PHILADELPHIA, PA 19103
Telephone: (215) 599-0600 - Facsimile: (215) 599-0601